

original "Brief Description of the Drawings" which is being deleted. Substitute therefor the following new paragraphs:

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**- -Brief Description of the Drawing**

A<sup>1</sup> The figure is a scanning view electron microscope (SEM) at an original magnification of 50X showing natural graphite flake sized in the range of 80 x 140 mesh.--

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Delete all paragraphs of the specification from page 12 line 10 through page 15 line 15 and insert therefor the following:

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A<sup>2</sup> --A compressed mass of expanded graphite particles is provided in the form of a flexible graphite sheet. As noted above, the graphite flake used in to produce the expanded graphite particles is sized such that no more than about 30% by weight of the flake is +80 mesh (U.S. standard screen). Most preferably, graphite flake is sized at least about 50% by weight 80 x 140 mesh, U.S. standard screen and has a moisture content of no greater than about 1.0%. The flexible graphite sheet is provided with channels, which are preferably smooth-sided, and which pass between the opposed surfaces of the flexible graphite sheet, and are separated by walls of compressed expandable graphite. The channels preferably have openings on one of the opposed surfaces which are larger than the openings in the other opposed surface. The channels can have different configurations which are formed using flat-ended protrusion elements of different shapes, suitably formed of metal, e.g. steel and integral with and extending from the pressing roller of the impacting

device. The smooth flat-ends of the protrusion elements, and the smooth bearing surfaces of a pair of rollers (or alternatively one roller and a flat metal plate), ensure deformation and complete displacement of graphite within the flexible graphite sheet, i.e. there are no rough or ragged edges or debris resulting from the channel-forming impact. Preferred protrusion elements have decreasing cross-section in the direction away from the pressing roller to provide larger channel openings on the side of the sheet that is initially impacted. The development of smooth, unobstructed surfaces surrounding channel openings, enables the free flow of fluid into and through smooth-sided channels.

<sup>2</sup>  
A cont In a preferred embodiment, openings on one of the opposed surfaces are larger than the channel openings in the other opposed surface, e.g. from 1 to 200 times greater in area, and result from the use of protrusion elements having converging sides. The channels are formed in the flexible graphite sheet at a plurality of pre-determined locations by mechanical impact at the predetermined locations in sheet using a mechanism comprising a pair of steel rollers with one of the rollers having truncated, i.e. flat-ended, prism-shaped protrusions which impact the surface of the flexible graphite sheet to displace graphite and penetrate the sheet to form open channels. In practice, both rollers can be provided with "out-of-register" protrusions, and a flat metal plate, can be used in place of a smooth-surfaced roller.

This orientation of the expanded graphite particles results in anisotropic properties in flexible graphite sheets; i.e. the electrical conductivity and thermal conductivity of the sheet being substantially lower in the direction transverse to the

opposed major surfaces ("c" direction) than in the direction ("a" direction) parallel to the opposed major surfaces. In the course of impacting the flexible graphite sheet to form channels, graphite is displaced within flexible graphite sheet by flat-ended protrusions to push aside graphite as it travels to and bears against the smooth surface of the roller to disrupt and deform the parallel orientation of the expanded graphite particles. This region, adjacent the channels, showing disruption of the parallel orientation into an oblique, non-parallel orientation is optically observable at magnifications of 100X and higher. In effect the displaced graphite is being "die-molded" by the sides of adjacent protrusions and the smooth surface of roller. This reduces the anisotropy in the flexible graphite sheet and thus increases the electrical and thermal conductivity of the sheet in the direction transverse to the opposed major surfaces. A similar effect is achieved with frusto-conical and parallel-sided peg-shaped flat-ended protrusions.

In the practice of the present invention, a gas permeable flexible graphite sheet is provided at one of its surfaces with a continuous, open groove, a fluid inlet and a fluid outlet to constitute a gas diffusing electrode. The groove of the present invention is suitably formed by pressing a hard metal die onto the inventive flexible graphite sheet material, *i.e.*, flexible graphite sheet having transverse channels passing therethrough from surface to surface. The die forms a continuous open groove in the surface contacted by the die. For a sheet of flexible graphite 0.15 mm to 0.32 mm thick, the open groove can be, for instance, 0.076 mm to 0.16 mm deep and 0.5 mm to 0.635 mm wide separated by lands that are 0.25 mm to 1.6 mm thick.

The perforated gas permeable flexible graphite sheet can be used as an electrode in an electrochemical fuel cell.

The basic elements of an electrochemical Fuel Cell are disclosed in U.S. Patents 4,988,583 and 5,300,370 and PCT WO 95/16287 (15 June 1995) each of which is incorporated herein by reference.

<sup>2</sup>  
A The Fuel Cell comprises electrolyte in the form of a plastic e.g. a solid polymer ion exchange membrane; perforated flexible graphite sheet electrodes in accordance with the present invention; and flow field plates which respectively abut the electrodes. Pressurized fuel is circulated through grooves of fuel flow field plate and pressurized oxidant is circulated through other grooves. In operation, the fuel flow field plate becomes an anode, and the oxidant flow field plate becomes a cathode with the result that an electric potential, i.e. voltage is developed between the fuel flow field plate and the oxidant flow field plate. The above described electrochemical fuel cell is combined with others in a fuel cell stack to provide the desired level of electric power as described in the above-noted U.S. Patent 5,300,370.

The operation of the Fuel Cell requires that the electrodes be porous to the fuel and oxidant fluids, e.g. hydrogen and oxygen, to permit these components to readily pass from the grooves through electrodes to contact the catalyst on the surfaces of the membrane, and enable protons derived from hydrogen to migrate through the ion exchange membrane. In the electrode of the present invention, channels are positioned to adjacently cover grooves of the flow field plates so that the pressurized gas from the grooves passes through the smaller openings of